08-04-00

A

PATENT **A-59709-3/JAS**

EXPRESS MAIL LABEL: EL 484659039 US
DEPOSITED: August 2, 2000
CERTIFICATE UNDER 37 CFR 1.10

I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited with the United States Postal Service on the above referenced date in an envelope as "Express Mail" addressed to the Box Patent Application, Assistant Commissioner for Patents, Washington, DC 20231.
Signed: Kari Bateman
Kari Bateman

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	**MACLEOD et al.**		
Serial No.:	**To be Assigned**	Art Unit No.:	**To be Assigned**
Filing Date:	**To be Assigned**	Examiner:	**To be Assigned**
For:	**METHOD TO REDUCE TORQUE RELATED AUDIBLE NOISE FOR SPINDLE MOTORS**		

NEW APPLICATION TRANSMITTAL
(37 C.F.R. § 1.53(b))

BOX PATENT APPLICATION
Assistant Commissioner for Patents
Washington, DC 20231

Sir:

1. **This new application is for an**

[X] Original (non-provisional)
[ ] Design
[ ] Plant

[X] divisional
[ ] continuation
[ ] continuation-in-part (C-I-P)

application under 37 C.F.R. 1.53(b), in the name of **Donald J. MacLeod, Santa Cruz, California; Greg Zariphopoulos, Redwood City, California; Robert M. Pelstring, Santa Cruz, California; Alain Cassat, Pully, Switzerland and Gunter Karl Heine, Aptos, California for "METHOD TO REDUCE TORQUE RELATED AUDIBLE NOISE FOR SPINDLE MOTORS"**. This divisional application claims priority to pending U.S. Application

Serial No. 09/198,047 filed November 23, 1998.

2. **Benefit of Prior U.S. Application(s)** (35 U.S.C. 119(e), 120, or 121)

[X] Enclosed is a copy of the prior application as originally filed.

[X] Priority of application Serial No. 09/198,047 filed November 23, 1998 is claimed under 35 U.S.C. 120.

[ ] the certified copy has been filed in prior application, Serial No. 0 / _____, filed on _____.

3. **Papers enclosed**:

Required for filing date under 37 C.F.R. § 1.53(b) (Regular) or 37 C.F.R. § 1.53 (Design) Application.

[ ] Enclosed is a new application.

[ ] Enclosed is a continuation-in-part application.

[X] Enclosed is a copy of the prior application as originally filed.

__7__ Pages of specification
__2__ Pages of claims
__8__ Sheets of drawings
[ ] formal
[X] informal
____ Page of abstract (blank)

4. **Additional papers enclosed**

[X] Amendment to Claims.

[X] Cancel in this application original claims __1-5__ before calculating the filing fee. (At least one original independent claim must be retained for filing purposes).

[ ] Add the claims shown on the attached amendment. (Claims added have been numbered consecutively following the highest numbered original claims).

[X] Amendment to Specification.

[X] Amend the specification by inserting before the first line the sentence:

– This divisional application claims priority to pending U.S. Application Serial No. 09/198,047 filed November 23, 1998. –

[ ] Preliminary Amendment

[ ] Copy of previously submitted Information Disclosure Statement (37 C.F.R. 1.98) with Form PTO-1449

[ ] Fee regarding Information Disclosure Statement:

[ ]	Fee Under 37 CFR 1.17(p)	$240.00
[ ]	Petition Fee Under 37 CFR 1.17(i)	$130.00

Total Information Disclosure Statement Fee: **$ 0.00**

[ ] Authorization of Attorney(s) to Accept and Follow Instructions from Representative.

[ ] Special Comments:

[ ] Other:

5. **Declaration or oath (including power of attorney)**

[X] Enclosed is a copy of the originally filed Declaration Executed by the

[X] inventor(s)

[ ] legal representative of inventor(s)

[ ] Joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.

[ ] This is the petition required by 37 C.F.R. 1.47 and the statement required by 37 C.F.R. 1.47 is also attached.

[ ] Not enclosed.

[ ] Application is made by a person authorized under 37 C.F.R. 1.41(c) on behalf of *all* the above named inventor(s).

[X] The Power of Attorney in the prior application is to:

Name: Flehr Hohbach Test Albritton & Herbert, L.L.P.
Address: Four Embarcadero Center, Suite 3400
San Francisco, California 94111-4815

[X] The power appears in the original papers in the prior application.

[ ] Since the power does not appear in the original papers, a copy of the power in the prior application is enclosed.

6. **Inventorship Statement**

The Inventorship for all the claims in this application are:

[X] the same inventors named in the prior application.

[ ] inventors fewer than all the inventors named in the prior application.

[ ] please delete the following name(s) as inventor(s):

[ ] Not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,

[ ] is submitted.

[ ] will be submitted.

7. **Language**

[X] English

[ ] Non English

[ ] The attached translation includes a statement that the translation is accurate. 37 C.F.R. 1.52(d).

8. **Assignment**

[ ] A copy of the assignment of the invention to: SEAGATE TECHNOLOGY, INC.

[ ] is attached. A separate [X] "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" OR [ ] FORM PTO 1595 is also attached.

[ ] will follow.

[X] The prior application is assigned of record to SEAGATE TECHNOLOGY, INC.

[X] A copy of the original recorded Assignment is enclosed.

[ ] A copy of the Change of Name in recorded Assignment is enclosed.

9. **Extension of time**

[ ] The term for response or taking action in the prior application expires on _____.

[ ] An extension of time in the prior application is:

[ ] filed concurrently in the prior application.

[ ] has been filed on _____.

[X] Applicant hereby petitions for an extension of time in prior application serial no. **09/198,047** and encloses the fee of: **$380.00**

	Small Entity			Large Entity	
[]	One month	$ 55.00	[]	One month	$110.00
[]	Two months	$190.00	[X]	Two months	$380.00
[]	Three months	$435.00	[]	Three months	$870.00
[]	Four months	$680.00	[]	Four months	$1,360.00
[]	Five months	$925.00	[]	Five months	$1,850.00

Extension of Time Fee: **$ 380.00**

10. **The filing fee has been calculated as shown below:**

For:	(Col. 1) No. Filed	(Col. 2) No. Extra	Rate	Small Entity Fee	Rate	Large Entity Fee
Basic Fee:				$		$690.00
Total Claims:	3 - 20	= 0	x $9 =	$-0-	x $18	$ .00
Indep. Claims	2 - 3	= 0	x $39 =	$-0-	x $78	$ .00
[ ] Multiple Dependent Claims Presented			+ $130 =	$-0-	+$ 260 =	$-0-

[ ] An amendment canceling extra claims is enclosed.

[ ] An amendment deleting multiple-dependencies is enclosed.

[ ] The fee for extra claims is not being paid at this time.

Total Filing Fee: **$690.00**

11. **Small Entity Statement(s)**

[ ] Statement(s) that this is a filing by a small entity under 37 C.F.R. §§ 1.9 and 1.27 is(are) attached.

[ ] Status as a small entity was claimed in prior application, serial no. _____, filed on _____, from which benefit is being claimed for this application under 35 U.S.C. § [ ] 119(e); [ ] 120; [ ] 121, or [ ] 365(c) and which status as a small entity is still proper and desired.

[ ] A copy of the statement in the prior application is included.

Total Other Fees: $ .00

TOTAL FEES: **$ 690.00**

[X] A check including the amount of the above indicated TOTAL FEES is attached.

[ ] Please charge Deposit Account No. 03-1600(A-59709-3/JAS) in the amount of $

[X] A check in the amount of $1,070.00 is attached.

[ ] No fee is required.

[X] Conditional Petition for Extension of Time:
An extension of time is requested to provide for timely filing if an extension of time is still required after all papers filed with this transmittal have been considered.

[X] The Commissioner is hereby authorized to charge any underpayment of the following fees associated with this communication, including any necessary fees for extension of time, or credit any overpayment to Deposit Account No. 06-1300(A-59709-3-JAS).

[X] Any filing fees under 37 CFR 1.16 including fees for the presentation of extra claims.

[X] Any patent application processing fees under 37 CFR 1.17.

[X] I hereby verify that the attached papers are a true duplicate of prior application Serial No. 09/198,047 filed November 23, 1998.

[X] Address all future communication to:
James A. Sheridan of Flehr Hohbach Test Albritton & Herbert LLP

Respectfully submitted,

James A Sheridan

James A. Sheridan, Reg. No. 25,435

Flehr Hohbach Test Albritton & Herbert LLP
Four Embarcadero Center, Suite 3400
San Francisco, CA 94111-4187
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METHOD TO REDUCE TORQUE RELATED AUDIBLE NOISE FOR SPINDLE MOTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Application Serial No. 09/158,641, filed 9/22/98 by Aiello et al., and U.S. Application Serial No. 08/893,626 filed 7/11/97 by Williams et al., both incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates generally to a brushless DC motor having a cylindrical air gap between rotor and stator, and especially designed for use for driving a rotating hard disc in a hard disc drive.

BACKGROUND OF THE INVENTION

In permanent magnet motors, interfering or parasitic torques may develop because of the interaction between the edges of the magnetized poles and the slots of the stator. In small size motors, such as are used in disc drives, these problems can be even greater. The radial thinness of the rotor magnet is required by the limited diameter of the motor itself. In such a small, high power motor, the air gap between the facing surfaces of the stator and rotor must also be minimized. The combination of high induction, the slotted stator, the minimal air gap, and the thinness of all the elements can easily lead to so-called torque unevenness or torque ripple.

The resulting running torque ripple in the motor is a source of audible noise. Since the disc drive is used in computers, such audible noise must be reduced in order for the product to be commercially successful.

It has been recognized that the reduction of torque ripple is an important goal. One current method known of reducing torque ripple is designing the spindle motor to have a trapezoidal back EMF (BEMF) wave form. Current methods used to achieve such trapezoidal BEMF include weak magnetization of the magnet pole

center, or selection of stator slot/number/magnetic pole member. For example, it is disclosed in European patent 291,219, U.S. Patent No. 8,847,712 Issued 07-11-89, that the number of stator poles should be kept approximately the same as the number of rotor poles. This is also taught to reduce torque fluctuations during starting or idling. However, in general according to the reference, this method requires at least nine wound coils per motor.

A problem with this approach is that in most known spindle motor configurations, other design considerations dictate the number of poles and slots to be used and the numbers are usually different. The selection of the number and arrangement of the poles and slots in most disc drive spindle motors is dictated by other considerations than the shape of the back EMF wave form.

Thus, the problem remains of providing a motor design which minimizes running torque ripple while remaining consistent with other design considerations for an efficiently operating disc drive spindle motor.

Another objective of the invention is to provide a motor design with reduced running torque ripple, even though the number of slots may be dramatically different.

SUMMARY OF THE INVENTION

Therefore it is a primary general objective of the present invention to provide a permanent magnet excited motor having reduced running torque ripple in order to diminish the audible noise generated by the motor.

It is a further objective of the invention to provide a motor especially for use as a spindle motor in a disc drive which has a design providing reduced running torque ripple while remaining consistent with other design objectives of a disc drive spindle motor.

A further objective of the invention is to provide reduced running torque ripple by shaping and measuring the back EMF ripple of the motor as providing an accurate representation of the running torque ripple.

These and other objectives of the present invention are achieved by shaping the magnetization wave form created by the interaction between the rotating magnet of an outer rotor magnet supporting hub rotating past a slotted stator normally energized in the normal fashion. The magnetization wave form is shaped to provide a back EMF shape with a substantially flat top when a two phase wave form for a standard three phase motor is studied. It has been recognized that in this type of motor, this back EMF wave form shape will minimize torque ripple. The flat peak is achieved by adding shoulders to a standard single phase wave form, by providing a ten to fifteen percent null zone between each magnetic pole. This may be achieved alternatively by providing a solid magnet which is magnetized to establish a null zone; by molding the magnet in essentially a cylindrical shape with teeth, each tooth being aligned to create a magnetic pole during magnetization, with the air gap between the teeth creating the desired transition zone, or by scalloping the magnets inner diameter at the desired pole transition zones.

Other details and advantages of the present invention will become apparent to a person of skill in this field who studies the following figures in conjunction with the description of a preferred embodiment or embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a vertical sectional view of a typical motor in which various embodiments of the present invention may be used;

FIGURE 2A is a graph of the permanent magnet MMF measured for one phase of the motor;

FIGURE 2B is a graph showing a single phase back EMF wave form; whereas

FIGURE 3 shows the combined effect of the back EMF of two phases in a motor utilizing a present invention;

FIGURE 4 shows a magnetizer for magnetizing a magnet having a magnet having the characterizations of the present invention;

FIGURE 5 shows an alternative molded magnet having the characteristics and advantages of the present invention.

FIGURES 6 and 7 show top plan views of further alternative embodiments of the invention.

FIGURE 8A is a top plan view of a magnetizer according to an embodiment of this invention.

FIGURE 8B is a top plan view of a portion of the magnetizer showing the resulting flux path.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 is a vertical sectional view of a typical motor with which any of the embodiments of the present invention could be used with a reduction in running torque ripple of the motor. The many details of the motor of course are not significant to the present invention but it is sufficient to note that it is a typical three phase motor of a type well known in the disc drive field, having a stator 10 supporting coils 12, interacting with a magnet 14 which is supported on the interior surface of an external hub 16. A disc or discs are supported on the exterior surface 18 of the motor for rotation at constant speed. A finite gap 20 is defined between

the stator and the motor i.e., bordered by the stator 10 on one side and the permanent magnets 14 on the opposite side.

The magnets 14 in such a motor are cylindrical in shape and comprise alternating north/south poles, with a transition region between each pole. For reasons explained above and already well known in this field, such a design is a well known source of running torque ripple because of the effects of the interaction between the magnetic poles and the stator as the transition edges of the magnetic poles pass the gaps in the stator.

In this improved motor, the magnets shown in Figures 3 and 4 are designed to exhibit an MMF across the air gap which incorporates a null zone in the transition region between the north and south poles. Preferably, this null zone should be about 10 to 15 degrees as shown in Figure 2A; it may be referred to as an "inflection" in the waveform. It has been determined that running torque ripple is minimized, if the combined back EMF wave form for two or more phases has a roughly trapezoidal shape. A multi-phase motor with a segmented magnet having a ten to fifteen percent null zone between poles generates in a back EMF shape where a single phase with shoulders generally indicated at 30 as shown in Figure 3. Combining the back EMF from two phases provides a back EMF characteristic having a trapezoidal shape with a flat top 40 as shown in Figure 3. The flat peak 40 results from the addition of the shoulders 30 on the single phase wave forms which, as is well known, are displaced one relative to the next so that their shoulder regions are additive.

The magnet with a null transition zone which is the essential feature of this invention may be formed by appropriate magnetization of a single cylindrical piece of magnetizable material. As shown in Figure 4, a cylindrical magnet 50 is placed in a magnetizer comprising the magnetizer core 52 and a slotted magnetizer back iron 54. The magnetizer shown in Figure 4 includes a sequence of coils, a typical one of which is represented by the "x" and "." 56, 58 representing the current flow into and out of the page flowing through the coil which in turn establishes the

magnetic field between core 52 and back iron 54 to magnetize the magnet 50 according to the desired pattern. Obviously, because of the existence of the physical slots 53 along the inner periphery of the back iron 54, there will be null transition zones of approximately the width of each slot created in the finished magnet 50. The finished magnet would then be mounted on a back iron such as back iron 19 as shown in Figure 1.

An alternative approach is shown in Figure 5 where the magnet 60 is shown molded or otherwise formed by known techniques in a cylindrical shape with teeth comprising successive poles 62, 64, 66 and so on. Each of the teeth 62, 66 would be appropriate aligned in a magnetizer to create the alternating magnetic poles; the air gaps 63 between the teeth would establish the ten to fifteen degree null transition zone.

As with the preceding embodiment, the magnet could probably be supported outside the stator windings on an appropriate back iron, with the upper solid region generally indicated at 68 forming the primary support for the magnet.

In another alternative embodiment shown in Figure 6, the magnet inner-diameter shown in a top view would be scalloped at the pole transition zones. The scallops would of course not be effectively magnetized in the magnetizer, thereby creating the desired null transition zones between the alternating poles of the magnets 70.

Yet another alternative is shown in Figure 7. This shows the use of separate magnetic sections 80, 82, 84 et seq. each separate and regularly attached, spaced by a gap 85 of about 15 degrees from the next adjacent pole. The pole pieces 80-84 would be separately magnetized, and attached to a back iron 87, achieving the same function as the back iron 19 shown in the motor of Figure 1. The spacing gaps 80, 85 would create the desired ten to fifteen degree null transition zone which provides the desired reduction in running torque ripple.

A further improvement in creating a null zone in a magnet, using a simplified magnetizer structure, is shown in Figure 8.

In Figure 8, the magnetizer core 52 includes paired wires of each polarity 56, 58 located close together so that flux fields 57, 59 are created around each pair of wires. A region 156, 158 which is a null zone is thereby created in the magnet 50 which is being magnetized. The flux field can also be shown in the example shown in Figure 8B which clearly illustrates the null zone where no flux is passing through the magnet resulting in a null region.

As is well known, the conductors are buried in the magnetic core, surrounded by insulating material 52. The current through the pairs of wires is flowing into or out of the page as indicated by an "x" or a ".".

As appears in Figure 8, the magnet 50 is separated both from the back iron 53 and the core 52 only by enough space to allow for a slip fit of the magnet into the magnetizer. However, a potential improvement lies in leaving an air gap 159 between the outer surface of the magnet and the inner surface of the back iron. This allows the transition between poles to be much more shallow reducing noise issues which might otherwise be created.

Other alternative approaches to the present invention may become apparent to a person of skill in the art who studies the present invention disclosure. Therefore, the scope of the present invention is to be limited only by the following claims.

WHAT IS CLAIMED IS:

1. A permanent magnet motor including a stator having windings and a generally cylindrical permanent magnet supported on the inner surface of a rotating hub, said cylindrical magnet including a plurality of said poles of alternating magnet polarity, said alternating polarity poles being located circumferentially adjacent each of said adjacent magnetic poles being separated from a next adjacent magnetic pole of said opposite polarity by a null region which extends only partially radially through said cylindrical magnet to create a null zone between adjacent poles relative rotation of said magnet and said windings establishing a back EMF characteristic having a substantially trapezoidal shape.

2. A permanent magnet motor as claimed in Claim 1 wherein said motor hub supports a back iron on its inner surface, said magnet being supported on said back iron.

3. A permanent magnet motor as claimed in Claim 1 wherein said sequence of poles extends circumferentially around an interior surface of a cylindrical back iron supporting said magnet, and each pole being separated from a next adjacent one of said poles by said null transition zone.

4. A motor as claimed in Claim 1 wherein each said pole is separated from an adjacent said pole by said non-magnetized transition zone of about ten to fifteen degrees of width angle.

5. A permanent magnet motor as claimed in Claim 3 wherein said null region is scalloped in cross section so that said radial extent of said null zone is minimized.

6. A magnetizer for magnetizing a magnet with a null zone intermediate alternating poles comprising an insulating core supporting pairs of axially directed wires, each pair of wires adapted to carry current in the same axial direction, and a back iron axially spaced from said core by a sufficient axial gap to allow said magnet to be magnetized to slip into said gap, the flux being shaped to create alternating magnetic poles separated by a null zone around said magnet.

7. A magnetizer as claimed in Claim 6 wherein said gap is of sufficient radial extent that a portion of said gap remains open when said magnet is inserted so that said transition zone of said magnet is softened.

8. A magnetizer for magnetizing a magnet with null zones intermediate alternating poles comprising

means for supporting said magnet in said magnetizer and

conductive means for creating a flux path through said magnet which establishes said null zones in said magnet.

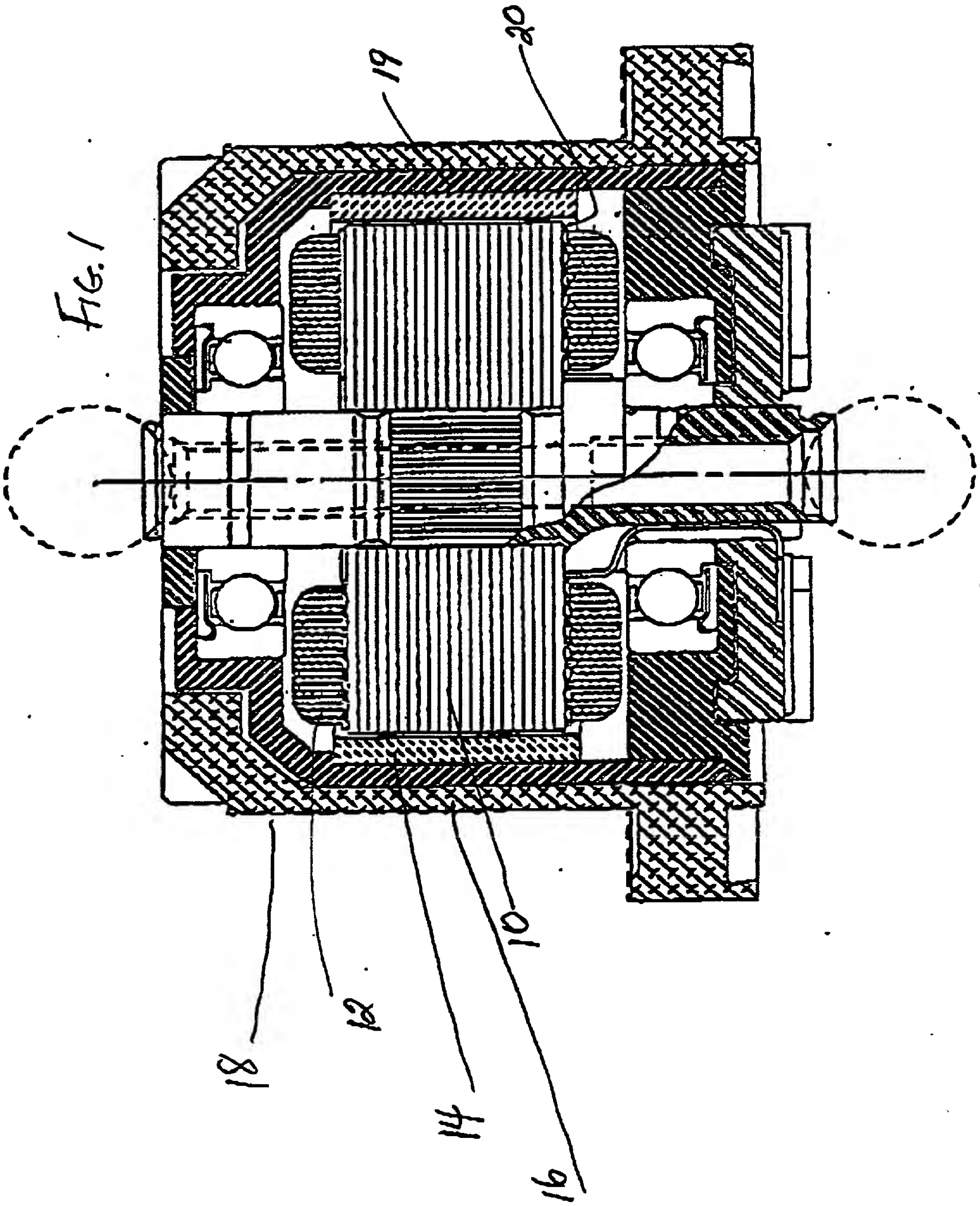
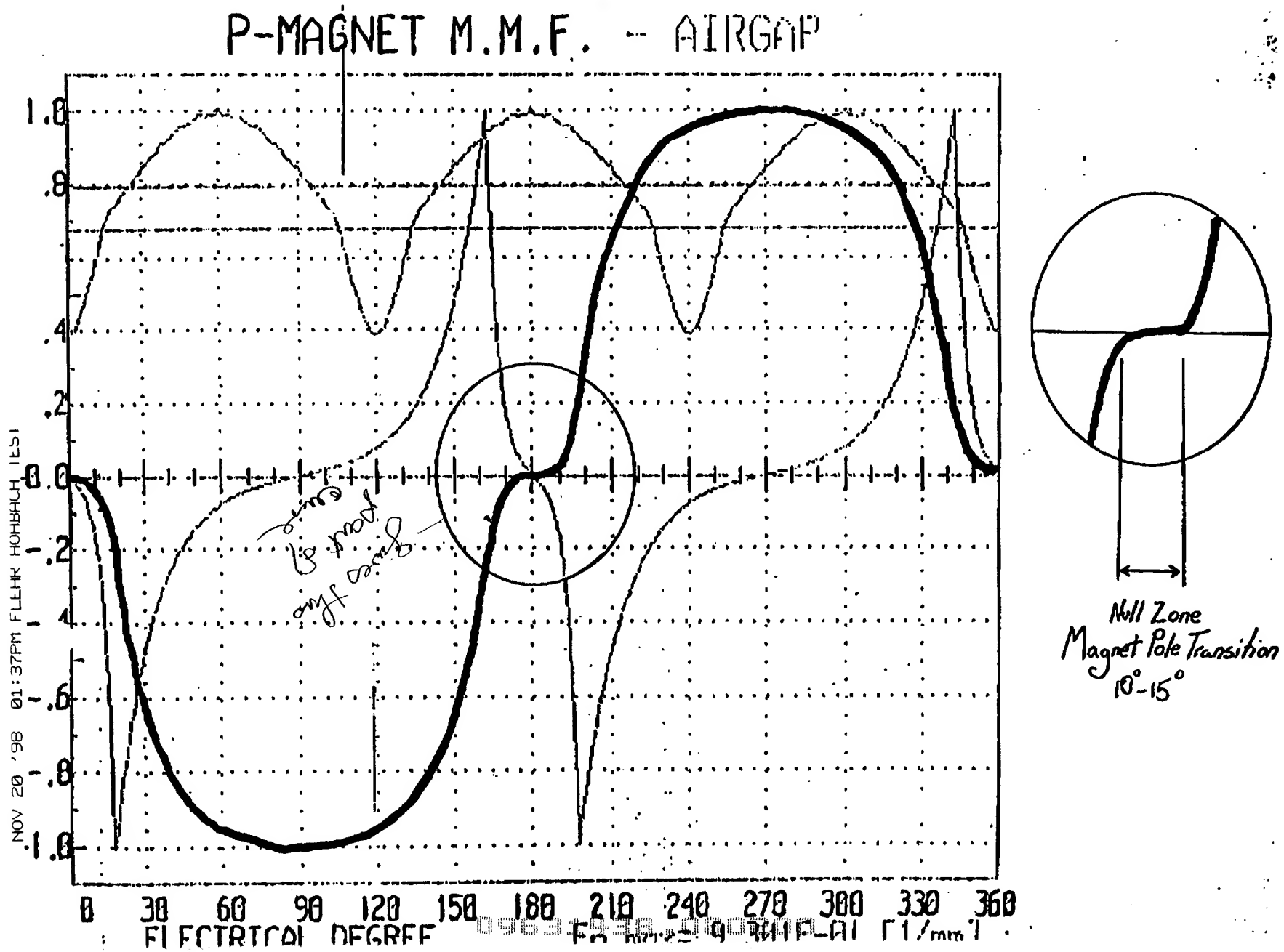


FIG. 1

Figure 2A


P-MAGNET M.M.F. - AIRGAP
1.0
.8
.4
.2
0.0
.2
.4
.6
.8
1.0
0
30
60
90
120
150
180
210
240
270
300
330
360
ELECTRICAL DEGREE
NOV 20 '98 01:37PM FLUKE HOHBACH (ES)

Null Zone
Magnet Pole Transition
10°-15°

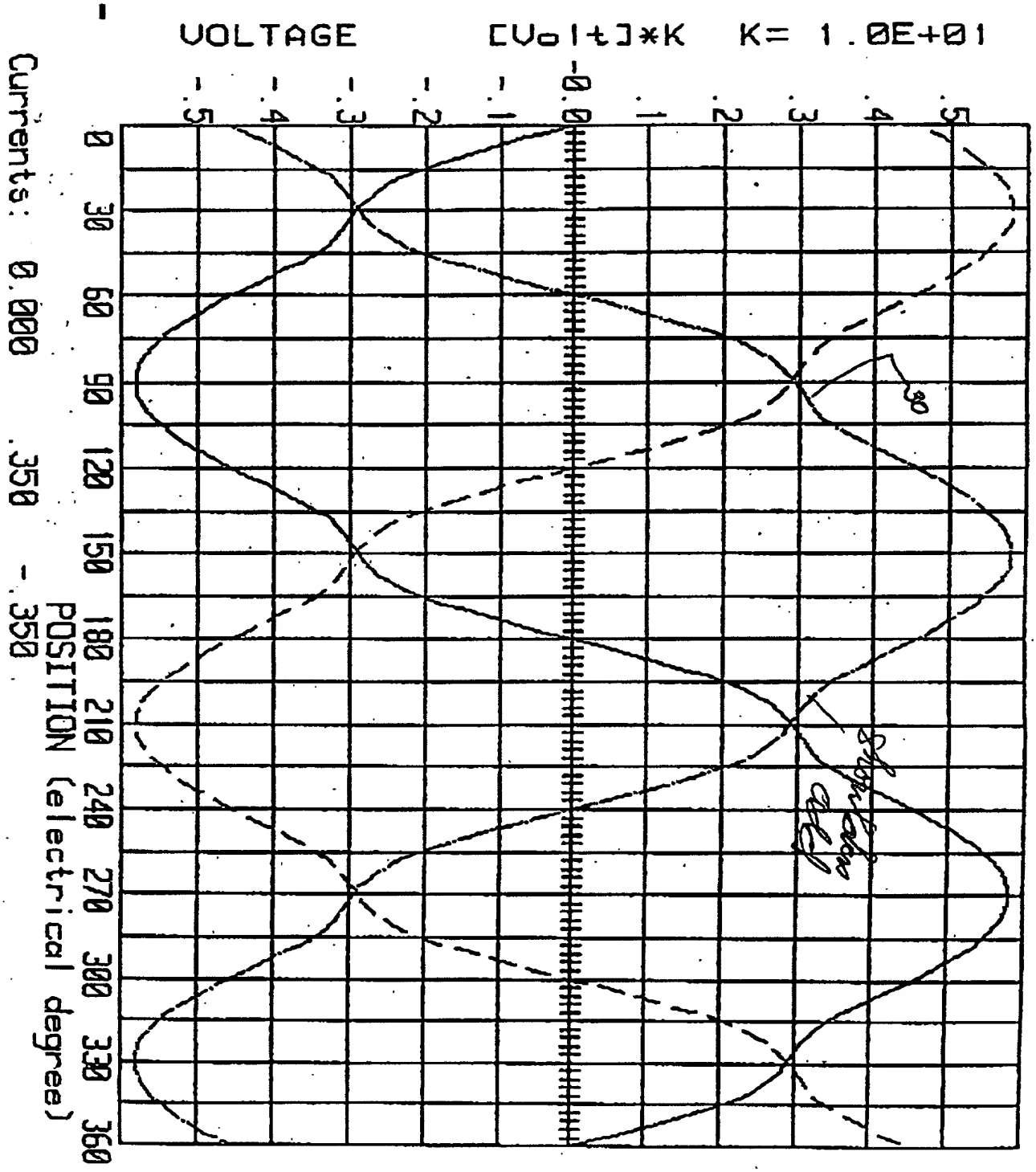


Figure 2B

PHASE BACK E.M.F.

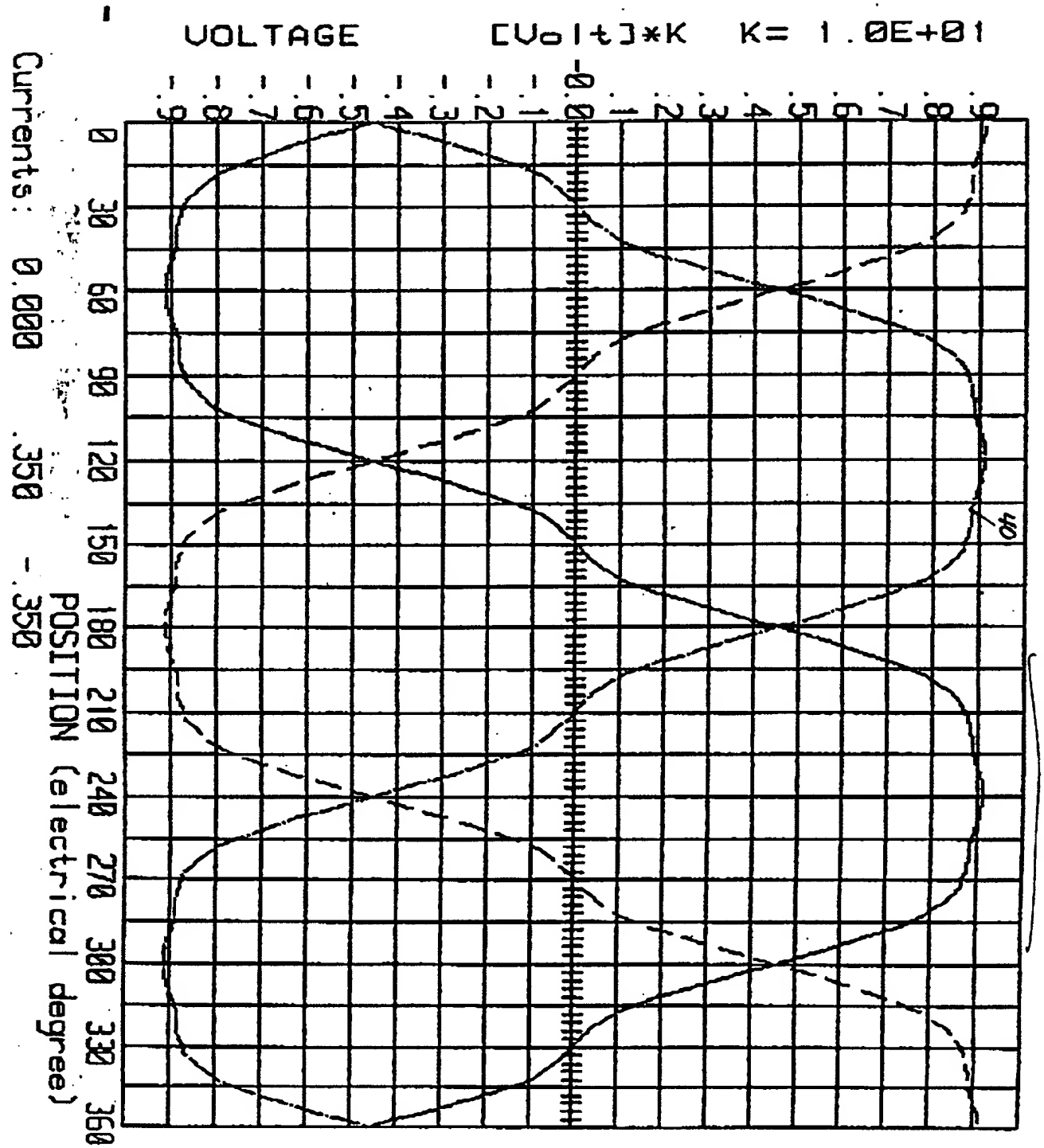


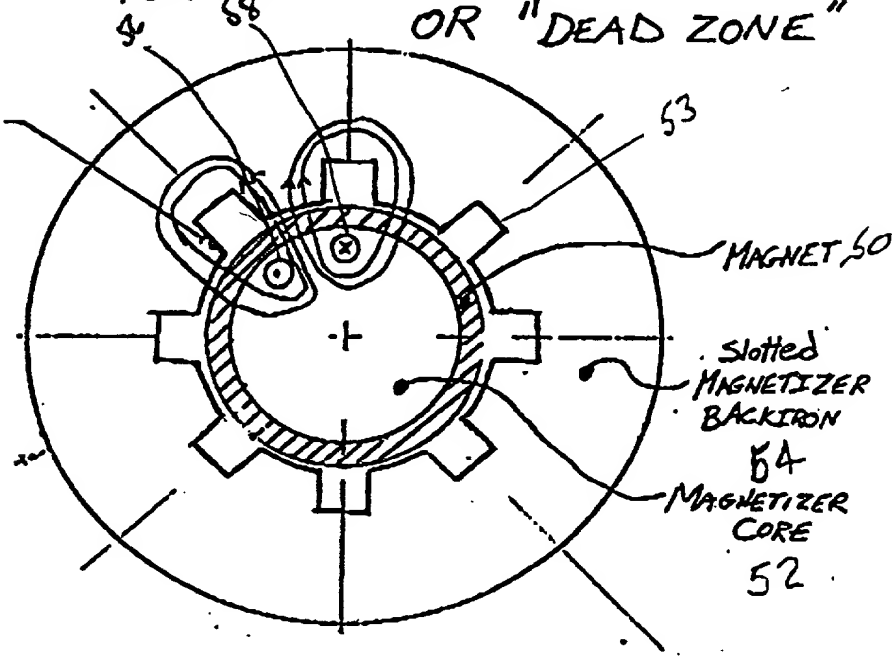
Figure 3

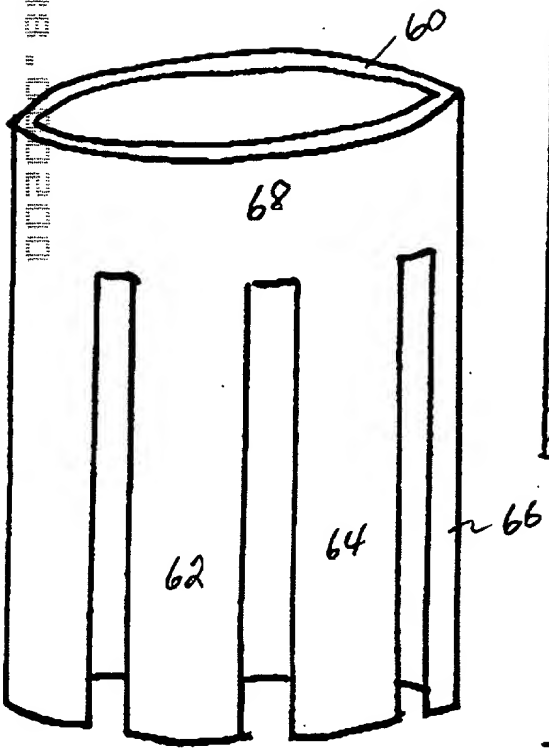
TWO PHASES BACK E.M.F.

Figure 4A

CUDA LP
25 Oct 93

MAGNETIZER DESIGN
FOR WIDE TRANSITION
OR "DEAD ZONE"





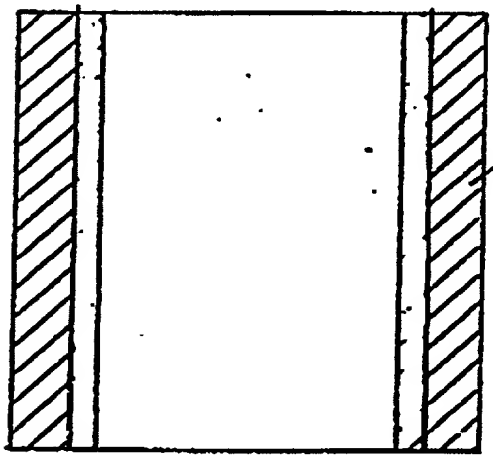


FIG 4B

Figure 5

FIG 6

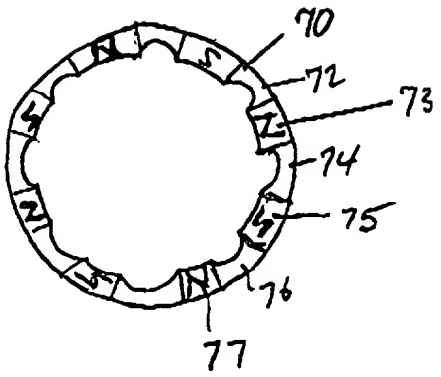


FIG. 7

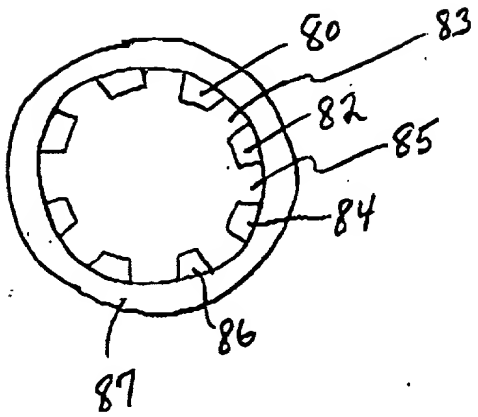
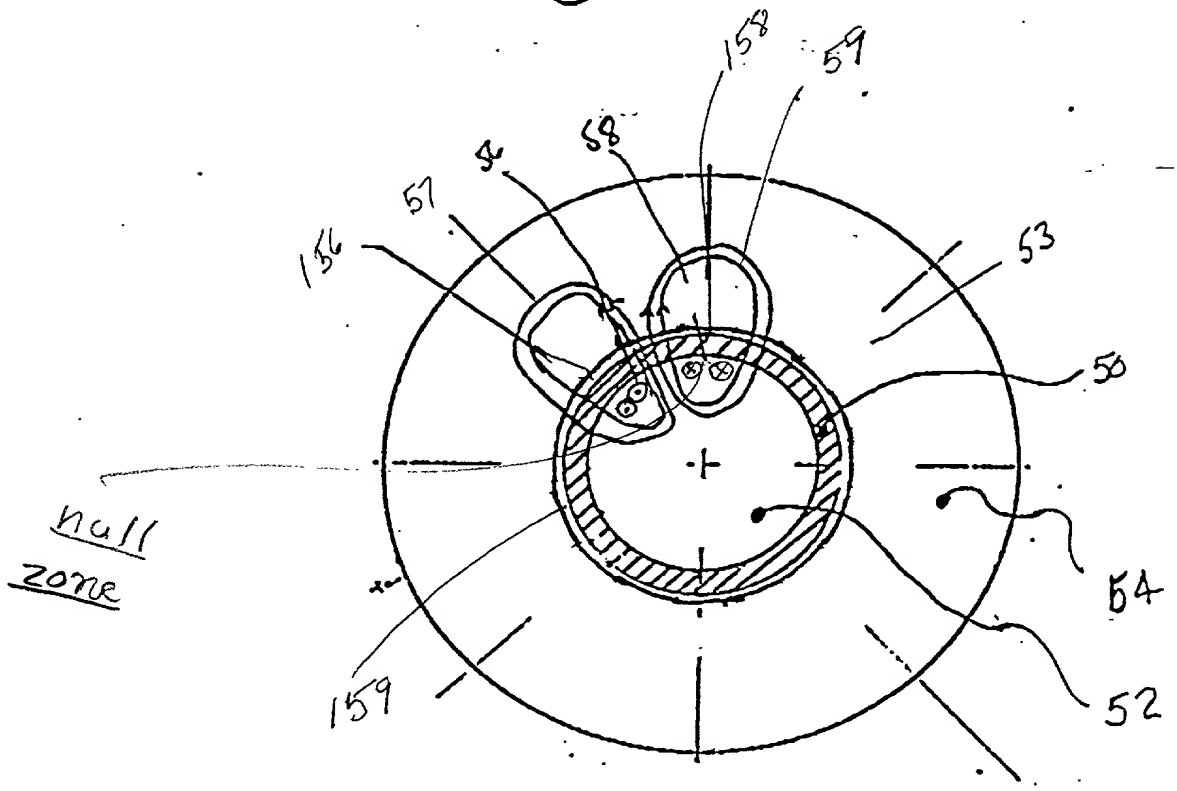
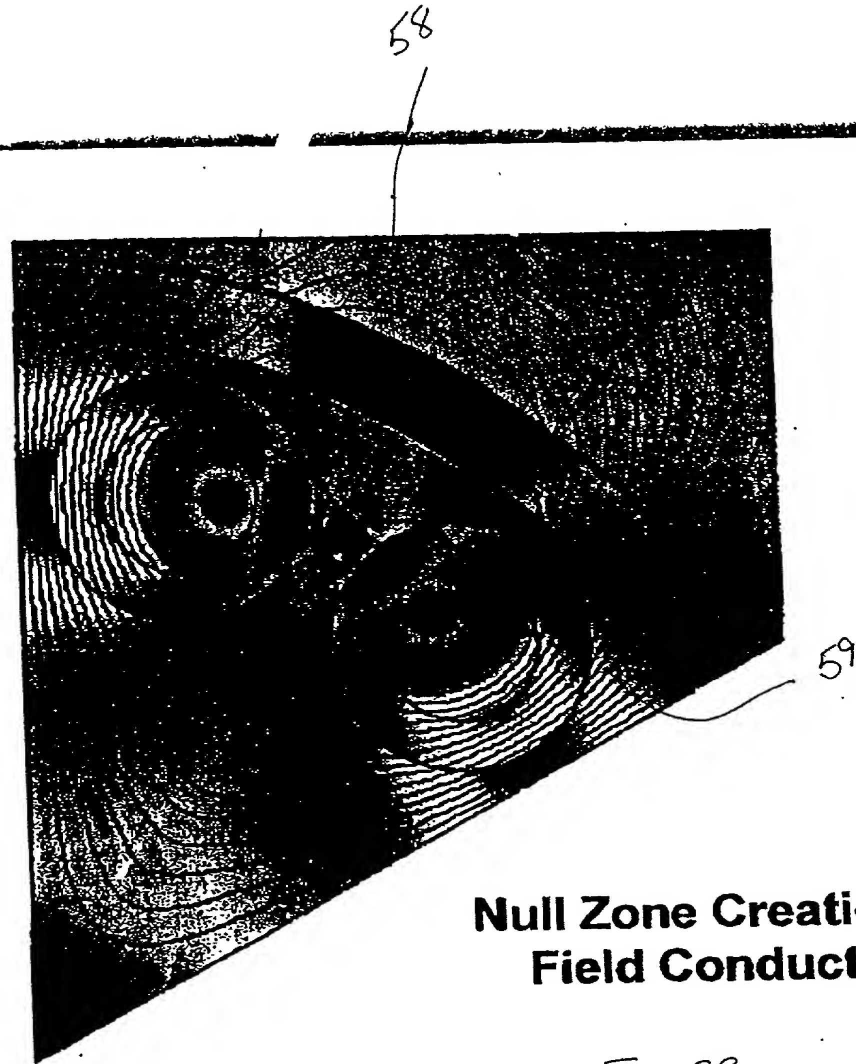


Figure: 8A





Null Zone Creation by Opposing Field Conductor Placement

FIG 8B

DECLARATION FOR PATENT APPLICATION

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled METHOD TO REDUCE TORQUE RELATED AUDIBLE NOISE FOR SPINDLE MOTOR , the specification of which:

(check one)
- ☐ is attached hereto.
- ☒ was filed on November 23, 1998 as Application Serial No. 09/198,047 and was amended on _____. (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in 37 C.F.R. 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	☐ Yes	☐ No
(Number)	(Country)	(Day/Month/Year Filed)	☐ Yes	☐ No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in 37 C.F.R. 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
09/158,641	September 22, 1998	Abandoned
08/893,626	July 11, 1997	Abandoned

Direct all telephone calls to James A. Sheridan at (415) 781-1989.
Address all correspondence to:

FLEHR HOHBACH TEST
ALBRITTON & HERBERT LLP
Suite 3400, Four Embarcadero Center
San Francisco, California 94111

File No. A-59709-2/JAS

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Title 18, United States Code, §1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of first inventor: Donald J. MacLeod

Inventor's signature:

Date:

Residence: Santa Cruz, California

Citizenship: United Kingdom

Post Office Address: 158 Waugh Avenue
Santa Cruz, California 95065

Full name of second inventor: Greg Zariphopoulos

Inventor's signature:

Date: 5/19/99

Residence: : Evanston, Illinois

Citizenship: Greece

Post Office Address: 1725 Orrington Avenue, Apt. #730-2
Evanston, Illinois 60201

Full name of third inventor: Robert M. Pelstring

Inventor's signature:

Date:

Residence: : Santa Cruz, California

Citizenship: U.S.A.

Post Office Address: 127 De La Costa Avenue

Santa Cruz, California 95060

Full name of fourth inventor: Alain Cassat

Inventor's signature:

Date:

Residence: Pully, Switzerland

Citizenship: Switzerland

Post Office Address: Fontanettaz 13

1009 Pully, Switzerland

Full name of fifth inventor: Gunter Karl Heine

Inventor's signature:

Date:

Residence: Aptos, California

Citizenship: Germany

Post Office Address: 143 Driftwood Court

Aptos, California 95003

DECLARATION FOR PATENT APPLICATION

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled METHOD TO REDUCE TORQUE RELATED AUDIBLE NOISE FOR SPINDLE MOTOR , the specification of which:

(check one)
- ☐ is attached hereto.
- ☒ was filed on November 23, 1998 as Application Serial No. 09/198,047 and was amended on _____. (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in 37 C.F.R. 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
			☐ Yes	☐ No
(Number)	(Country)	(Day/Month/Year Filed)		
			☐ Yes	☐ No
(Number)	(Country)	(Day/Month/Year Filed)		

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in 37 C.F.R. 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

09/158,641 (Application Serial No.)	September 22, 1998 (Filing Date)	Abandoned (Status) (patented, pending, abandoned)
08/893,626 (Application Serial No.)	July 11, 1997 (Filing Date)	Abandoned (Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

Direct all telephone calls to James A. Sheridan at (415) 781-1989.
Address all correspondence to:

FLEHR HOHBACH TEST
ALBRITTON & HERBERT LLP
Suite 3400, Four Embarcadero Center
San Francisco, California 94111

File No. A-59709-2/JAS

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Title 18, United States Code, §1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of first inventor: Donald J. MacLeod

Inventor's signature:

Date: 3/19/99

Residence: Santa Cruz, California

Citizenship: United Kingdom

Post Office Address: 158 Waugh Avenue
Santa Cruz, California 95065

Full name of second inventor: Greg Zariphopoulos

Inventor's signature:

Date:

Residence: : Redwood City, California

Citizenship: Greece

Post Office Address: 463 Jeter Street
Redwood City, California

Full name of third inventor: Robert M. Pelstring

Inventor's signature: R. M. Pelstring

Date: 3/19/99

Residence: : Santa Cruz, California

Citizenship: U.S.A.

Post Office Address: 127 De La Costa Avenue

Santa Cruz, California 95060

Full name of fourth inventor: Alain Cassat

Inventor's signature:

Date:

Residence: Pully, Switzerland

Citizenship: Switzerland

Post Office Address: Fontanettaz 13

1009 Pully , Switzerland

Full name of fifth inventor: Gunter Karl Heine

Inventor's signature: Gunter Heine

Date: 3-24-99

Residence: Aptos, California

Citizenship: Germany

Post Office Address: 143 Driftwood Court

Aptos, California 95003

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			☐	☐
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
			☐	☐
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

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Date:

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Citizenship: Greece

Post Office Address: 463 Jeter Street
Redwood City, California

Full name of third inventor: Robert M. Pelstring

Inventor's signature:

Date: 3/19/99

Residence: : Santa Cruz, California

Citizenship: U.S.A.

Post Office Address: 127 De La Costa Avenue

Santa Cruz, California 95060

Full name of fourth inventor: Alain Cassat

Inventor's signature:

Date: April 2, 1999

Residence: Pully, Switzerland

Citizenship: Switzerland

Post Office Address: Fontanettaz 13

1009 Pully, Switzerland

Full name of fifth inventor: Gunter Karl Heine

Inventor's signature:

Date:

Residence: Aptos, California

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